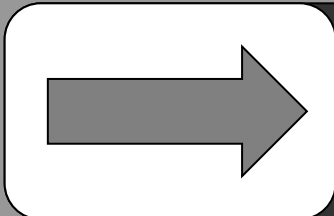


Wed Nov 5th 2014.

CIVL 498C Life Cycle Assessment

Week 10: Uncertainty in LCA



slide to unlock

Types of Uncertainty at each LCA stage

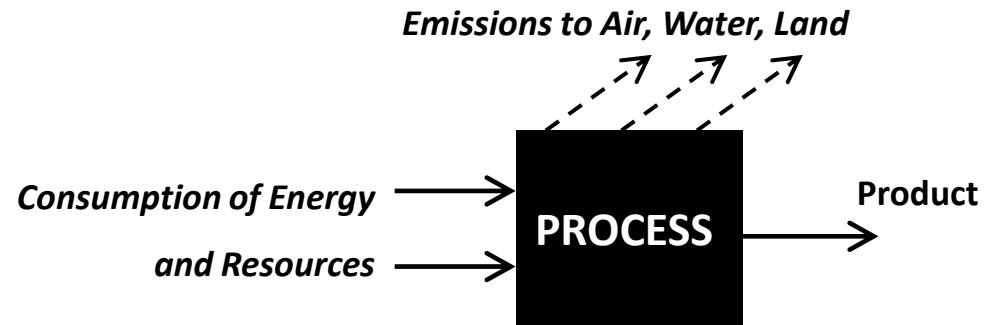
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Model Uncertainty		5. Linear vs. non-linear modeling	3. Characterization factors not known or uncertain
Uncertainty due to choices	1. Functional unit, 2. System boundary 3. Service life 4. Maintenance cycles, 5. Methods and 6. Tools used in modeling, 7. Choice of allocation methods, 8. IA Method and 9. IA Categories		
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Variability between objects/sources		9. Difference b/n Factories/ 10. Technologies which produce same product	8. Differences in human exposure patterns
Mistakes	10. Any	11. Any	9. Any

Data Uncertainty

Type	Goal & Scope	Inventory Analysis	Impact Assessment
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Quantitative Data Collection

Measure amounts of all required *flows* crossing your System Boundary as per your G&S.



Qualitative Data Collection

Describing

- ☐ age of data to be used
- ☐ technology of the process
- ☐ origin of raw materials
- ☐ locality of process
- ☐ impacted environments

Support your allocation

- ☐ prices
- ☐ physical relationships

Transportation

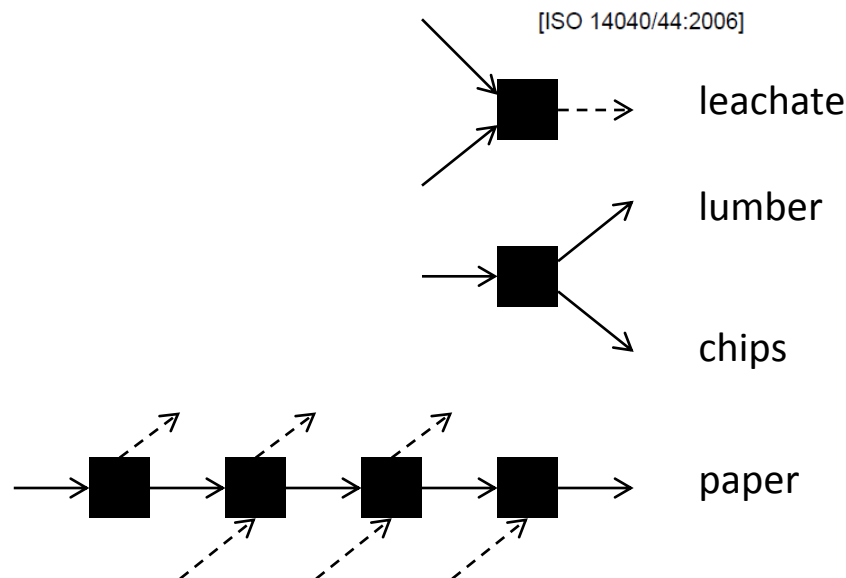
- ☐ distance
- ☐ routing
- ☐ type

Data Uncertainty

Inventory Analysis
1. Collection/ 2. Allocation methods used to create data 3. Inaccurate or 4. No data

Allocation

- Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems.



Documentation – Data collection

Nomenclature developed within CPM and published in CPM-report 1997:6, Pålsson A-C. "Handbok vid arbete med datakvalitet och SPINE".

Data collection	Explanation
Derived, statistics	Result from calculation that are solely based on statistically acquired data, and that has been processed with statistical methods.
Derived, mixed	Result from calculation that are based on several different datatypes, and where none of the initial values are of the type 'Unspecified'
Derived, unspecified	Result from calculation that are based on several different types of methods, and where one or more of the initial values are of the type 'Unspecified' or 'Derived, unspecified'.
Modeled data	Data that are based, entirely or for the most part, on theoretical modelling
Estimated from similarity	Data that has been estimated with data from a similar process.
Economical information	Data that is based on economical information such as purchasing or sales statistics.
Monitored data, continuous	Data based on continuous monitoring
Monitored data, discrete	Data based on discrete monitoring
Random samples	Data based on random samples
Single sample	Data based on a single sample.
Unspecified	The basis for the data is not specified
Unspecified, expert outspoke	The data is based on a statement made by an expert in the field.
Unspecified, guesstimate	The data is based on an estimation.
Unspecified, panel judgement	The data is based on a judgement made by a panel.
Legislated limit	Limit that has been prescribed by law, on e.g. a national level.
Corporate limit	Limit set for or by a specific company, e.g. according to an environmental management system

http://www.ciraig.org/Calendrier/document/methods_open_loop_caroline_gaudreault.pdf

http://cpm.database.cpm.chalmers.se/Document/CPM_Report_2003_3_Introduction_and_guide.pdf

Data Uncertainty

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Eutrophication Cause Effect Chain

Water emission

Dead biomass
bacterial
decomposition leads
to oxygen shortage

Death of fish and shellfish

Toxicity to humans,
marine mammals,
livestock

Algae and Aquatic
weed growth

Algae bloom
releasing toxics
leads to poisoning
fish and shellfish



Data Uncertainty

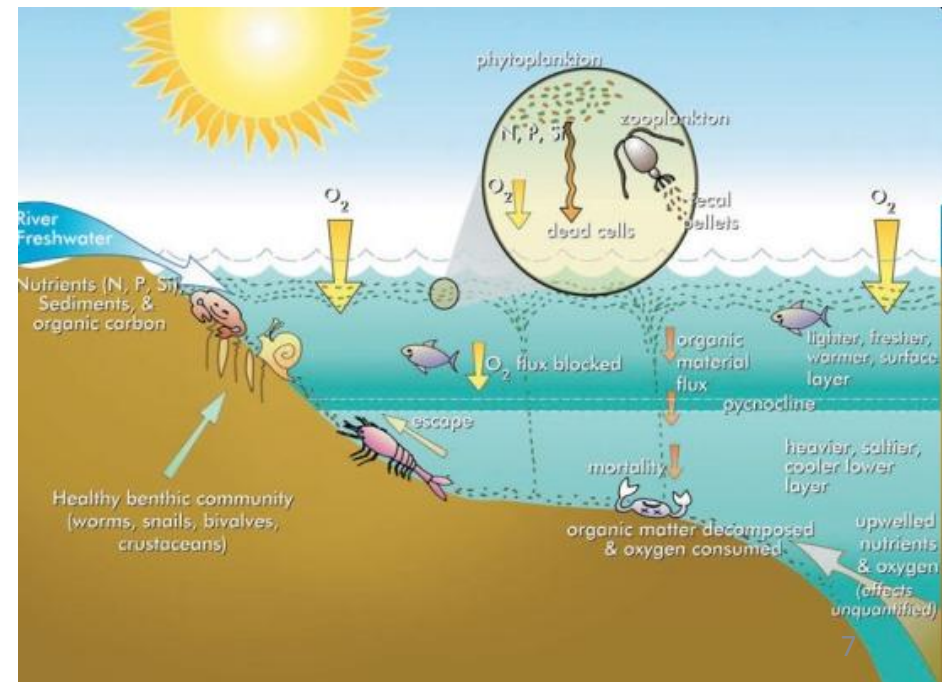
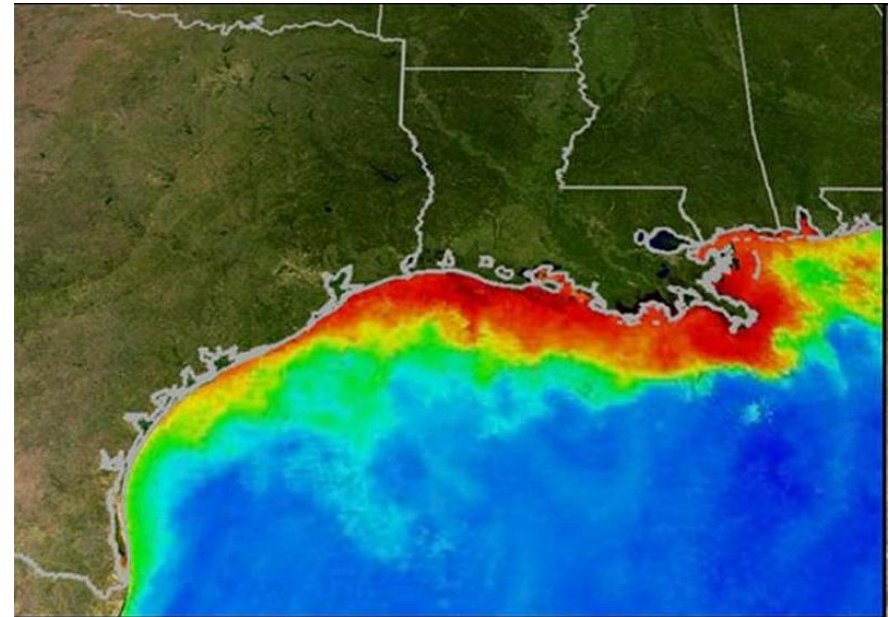
Impact Assessment
1. Uncertainty in Lifetimes of substances
2. Travel potential

Eutrophication Potential

- Category indicator (TRACI**)
 - kg N eq
- Midpoint impact
 - Influence on algae growth in nutrient deficient surface waters
 - Takes into account transport and probability of arriving in aquatic environment
 - Relative to algae growth in photic zone of aquatic ecosystem as result of 1kg of Nitrogen

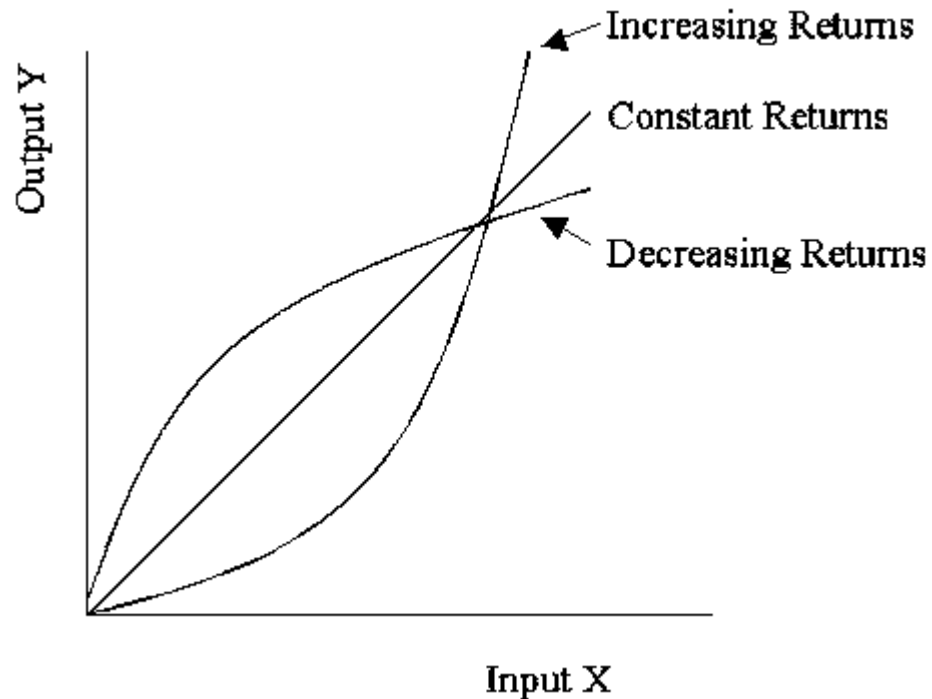
**See -

<http://www.epa.gov/ordntrnt/ORD/NRMRL/std/traci/traci.html>



Model Uncertainty

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Data Uncertainty		1. Collection/ 2. Allocation methods used to create data 3. Inaccurate or 4. No data	1. Uncertainty in Lifetimes of substances 2. Travel potential
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Uncertainty due to Choices

Goal & Scope

1. Functional unit,
2. System boundary
3. Service life
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PAPER TYPES

Paper can be separated into two main categories: uncoated and coated stocks.

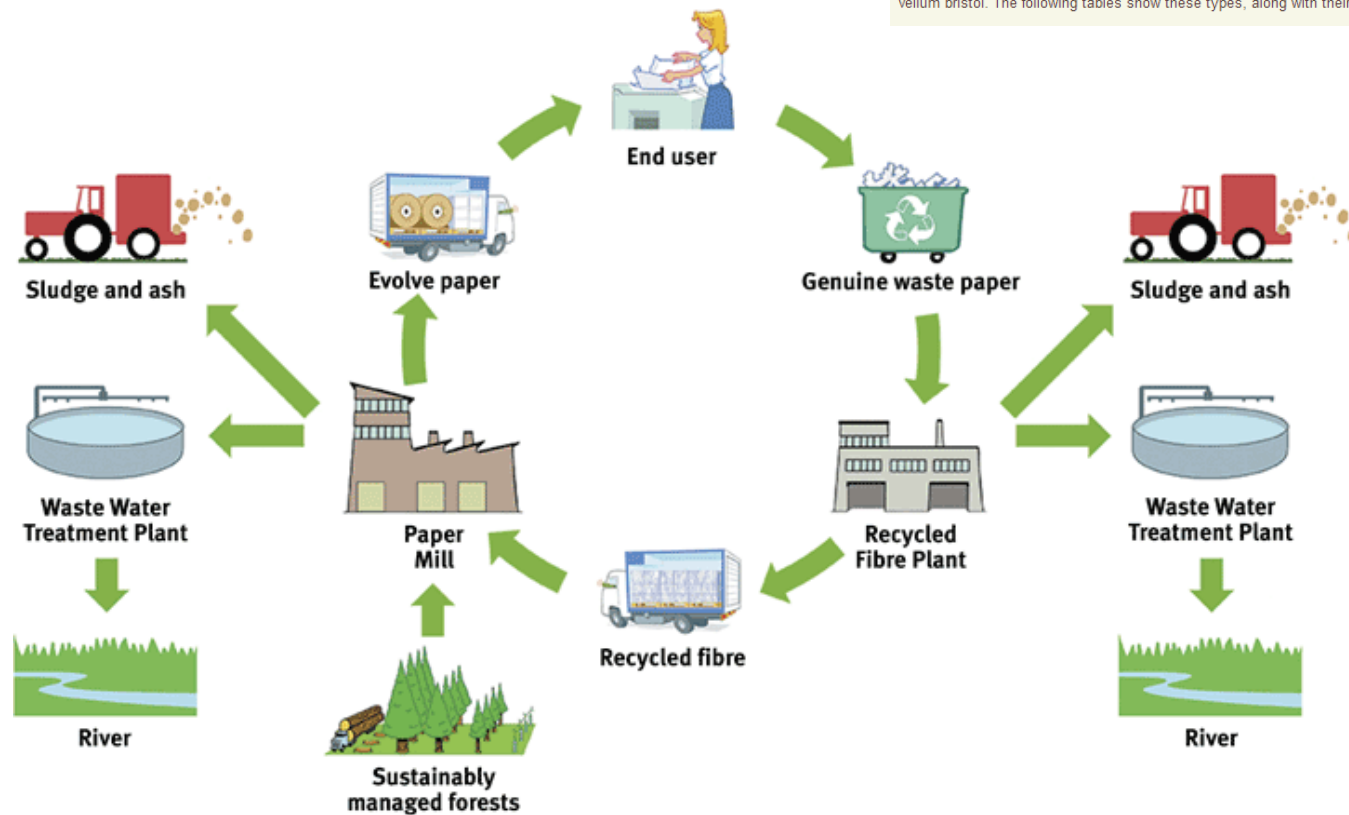
Uncoated stocks:

Uncoated stock is paper that has no coated pigment applied to reduce the absorbency or increase the smoothness. The uncoated finishes can be described as vellum, antique, wove, or smooth.

Coated stocks:

A coated stock has a surface coating that has been applied to make the surface more receptive for the reproduction of text and images in order to achieve sharper detail and improved color density. By adding a coated clay pigment, the objective of coating the stock is to improve the smoothness and reduce the absorbency. Coated paper finishes can be categorized as matte, dull, cast, gloss, and high gloss. The coating can be on both sides of the stock (coated two sides, "C2S") or on one side only (coated one side, "C1S").

From these subcategories, paper stocks are then separated into types such as offset, bond, cover, index, and vellum bristol. The following tables show these types, along with their common colors, weights, and uses.



Uncertainty due to Choices

Goal & Scope

1. Functional unit,
2. System boundary
3. Service life
4. Maintenance cycles,
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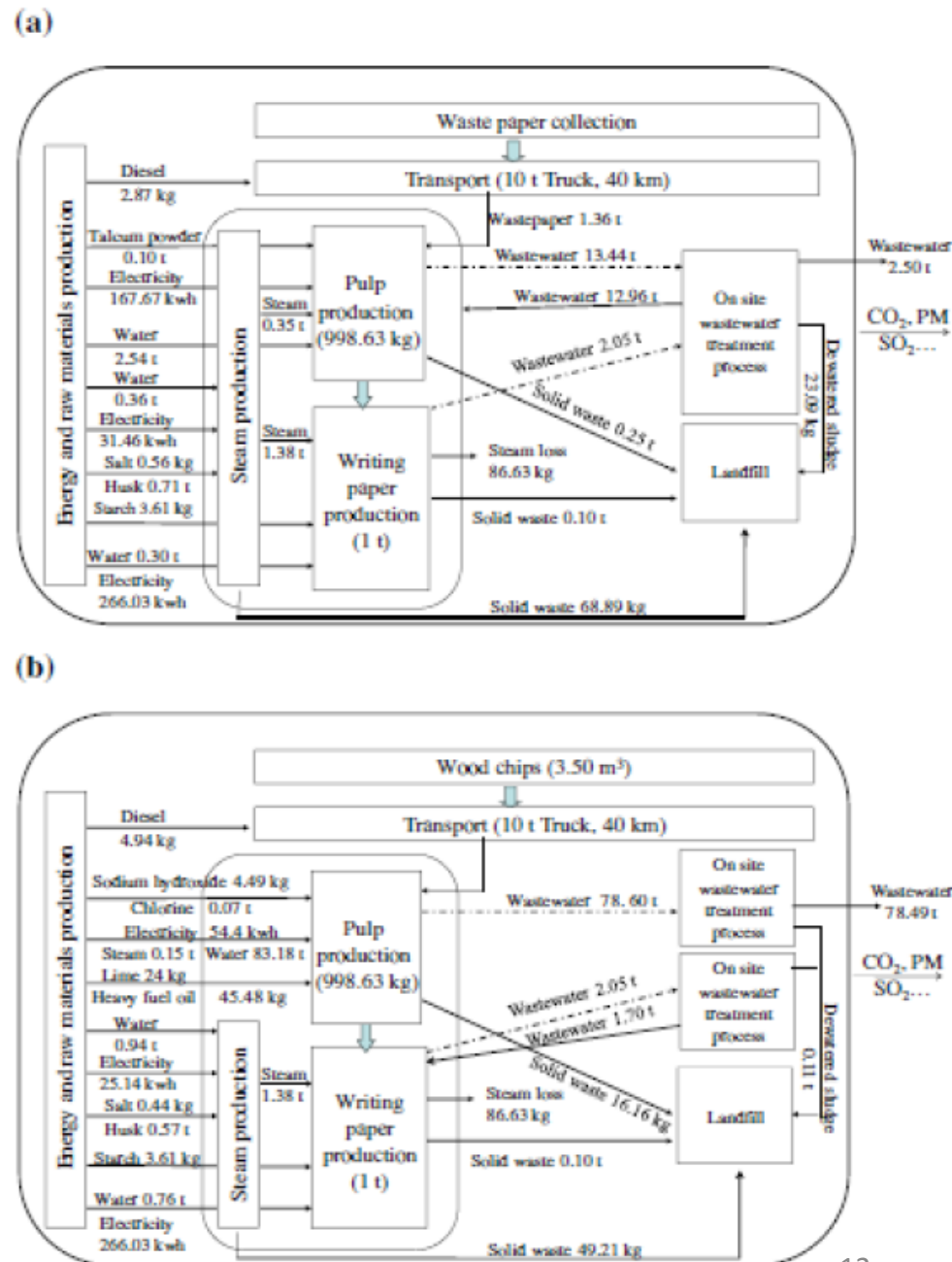
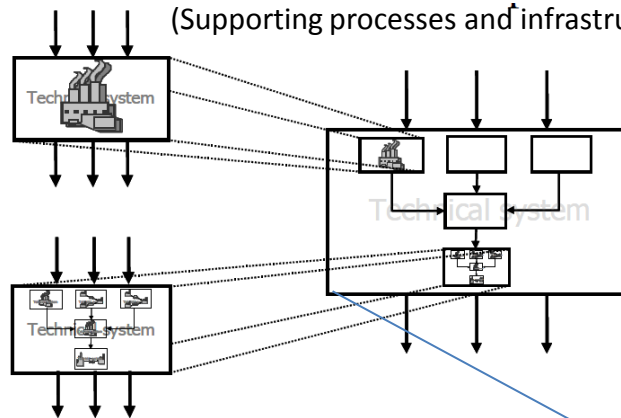


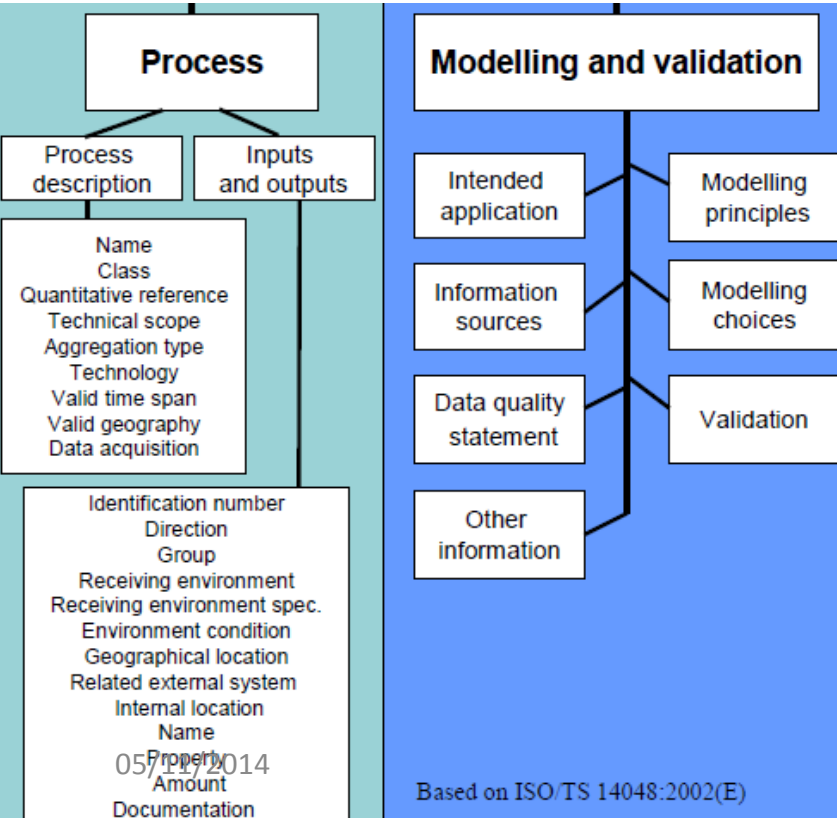
Fig. 1. System boundary and material flow. (a) Wastepaper pulp-based scenario (b) wood pulp-based scenario.

Background Data

(Supporting processes and infrastructures)



Data Documentation



Based on ISO/TS 14048:2002(E)

Foreground Data

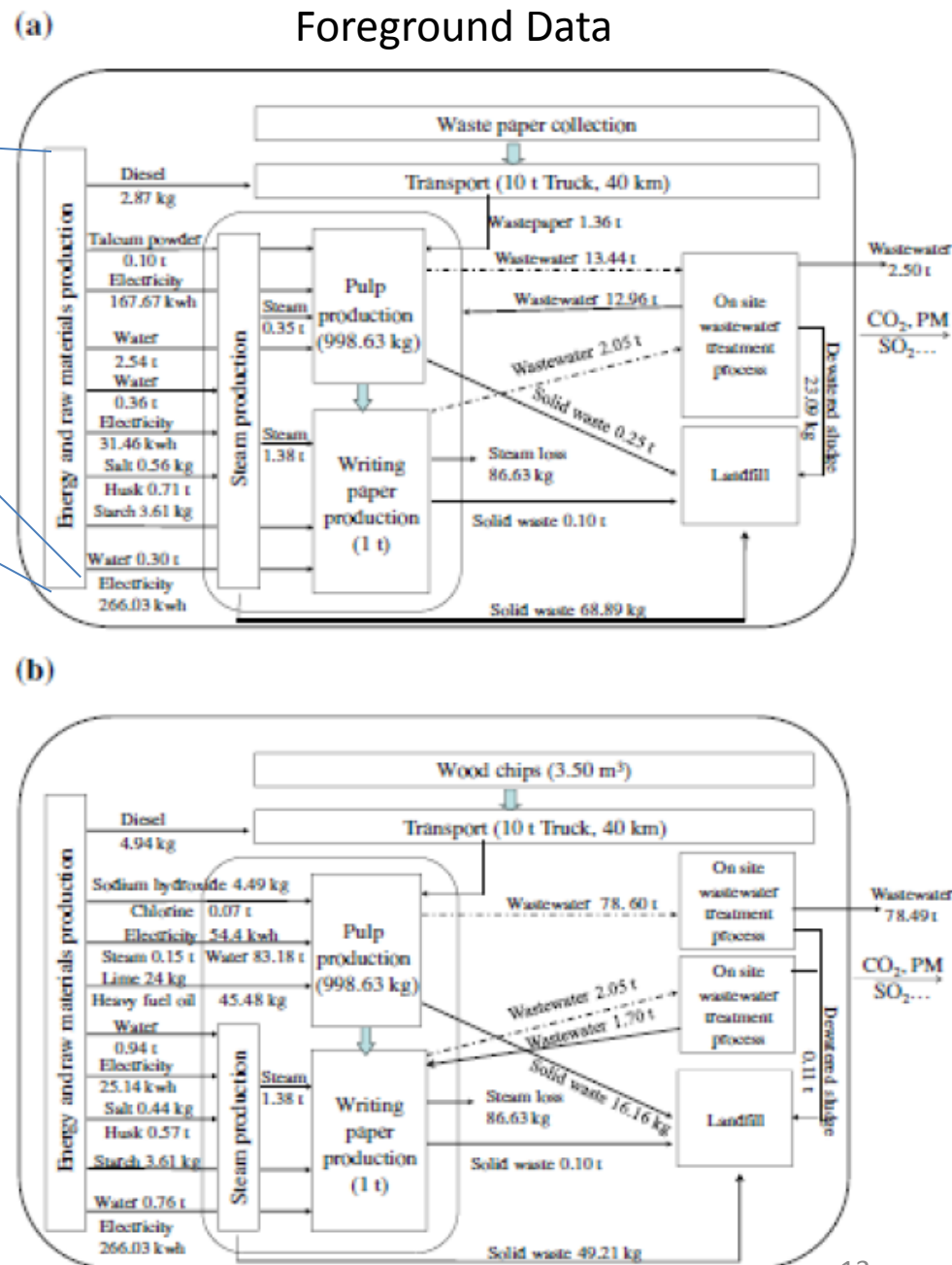


Fig. 1. System boundary and material flow. (a) Wastepaper pulp-based scenario (b) wood pulp-based scenario.

Uncertainty due to Choices

Goal & Scope

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Increasing need for
complexity and
knowledge of LCA

Different LCA Tools

Country		Comments
Level 1A Tools		
SimaPro	Netherlands	While the countries of origin vary, these tools can be used in different regions by selecting or incorporating the appropriate data. But the task is best done by LCA practitioners for whom the tools are intended.
GaBi	Germany	
Umberto	Germany	
TEAM	France	
Level 1B Tools		
BEES	USA	Combines LCA and life cycle costing. Includes both brand-specific and generic data.
LCAiT	Sweden	Streamlined LCA tool for product designers and manufacturers.
TAKE-LCA	Finland	LCA tool for comparison of HVAC products, including energy content of the product and energy consumption.
Level 2 Tools		
Athena Environmental Impact Estimator (EIE)	Canada/USA	All of these tools use data and incorporate building systems that are specific to the country or regions for which they were designed.
BRI LCA (energy and CO2)	Japan	
EcoQuantum	Netherlands	
Envest	United Kingdom	
Green Guide to Specifications	United Kingdom	
LISA	Australia	
LCADesign (under development)	Australia	
Level 3 Tools		
BREEAM	United Kingdom	Uses LCA results from the Level 2 Green Guide.
GBTool	International	Experimental platform that accepts LCA results or performs a rudimentary LCA calculation using built-in calculators.
Green Globes	Canada/USA	Assigns a high percentage of resource use credits based on evidence that a design team has conducted LCA using a recognized Level 1 or 2 tool.

Uncertainty due to Choices

Goal & Scope

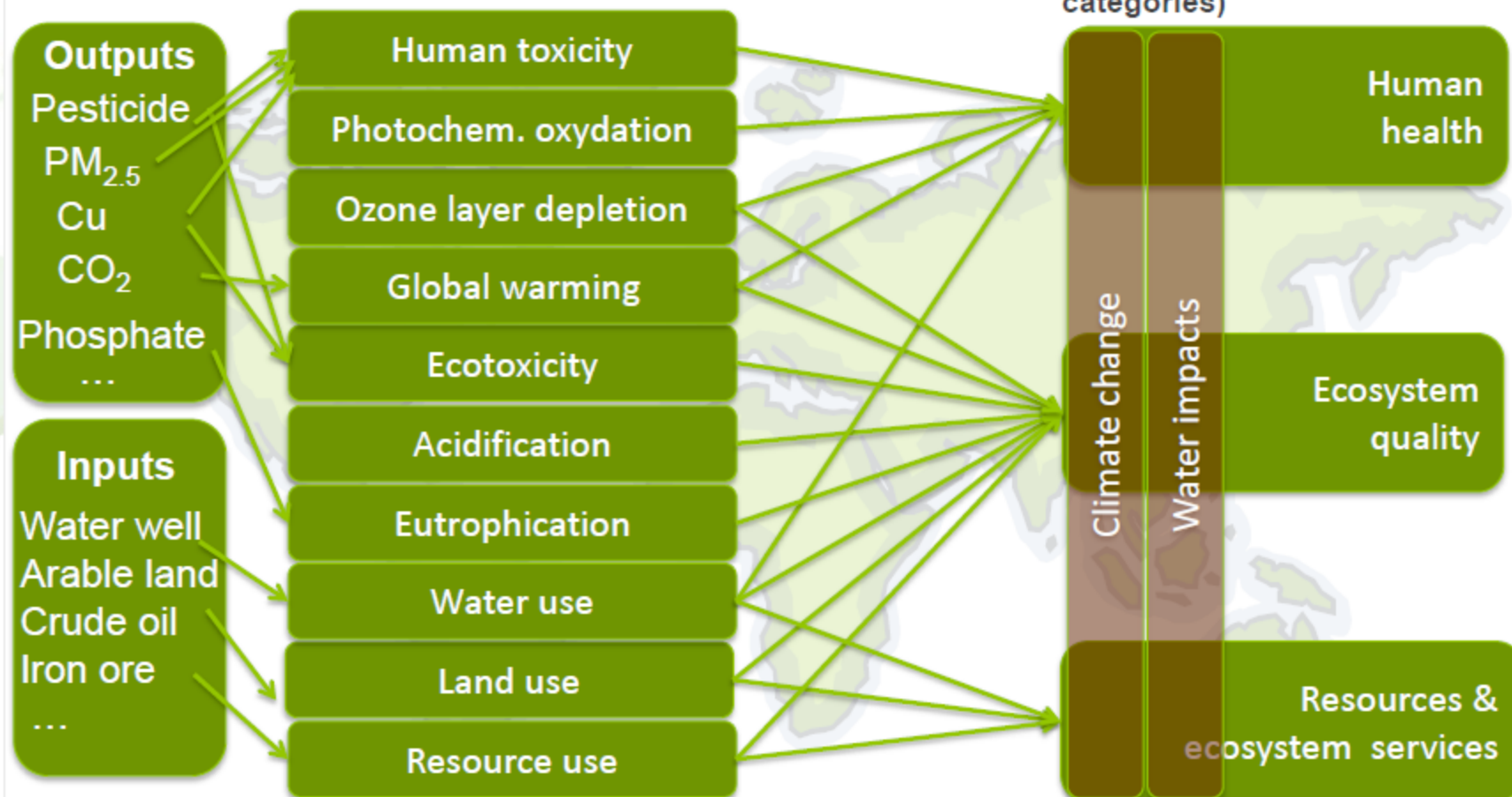
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Impact Assessment Methodology	Method description	Website Access Point
Eco-indicator 99	Damage approach, including Normalization and default weighting sets	www.pre.nl/eco-indicator99/
EDIP97	Midpoint method with normalization	http://ipt.dtu.dk/~mic/Projects.htm#EDIP97
EDIP2003	Midpoint method with normalization	http://ipt.dtu.dk/~mic/Projects.htm#EDIP2003
EPS 2000d	Category indicators at damage level + weighting as WTP to avoid damage	http://eps.esa.chalmers.se/
(Dutch) LCA Handbook	Midpoint method with normalization	http://www.leidenuniv.nl/cml/ssp/projects/lca2/lca2.html
IMPACT 2002(+)	Midpoint + damage including normalization	http://www.epfl.ch/impact
ReCiPe	Midpoint + damage including normalization	www.lcia-recipe.info/
TRACI	Midpoint method with normalization	http://epa.gov/ORD/NRMRL/std/sab/iam_traci.htm

IMPACT World+ Framework

Groups of midpoint categories

Damage or endpoint



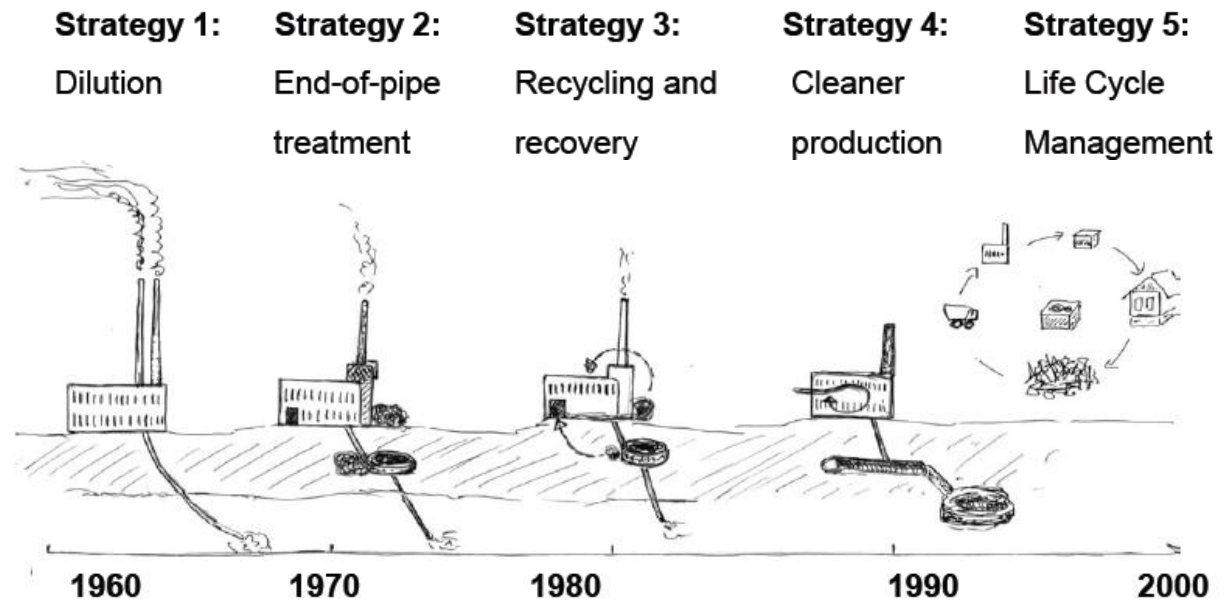
Temporal Variability

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Temporal Variability

Inventory Analysis
6. Difference in yearly factory emissions
7. Data vintage

Evolution of Environmental Management



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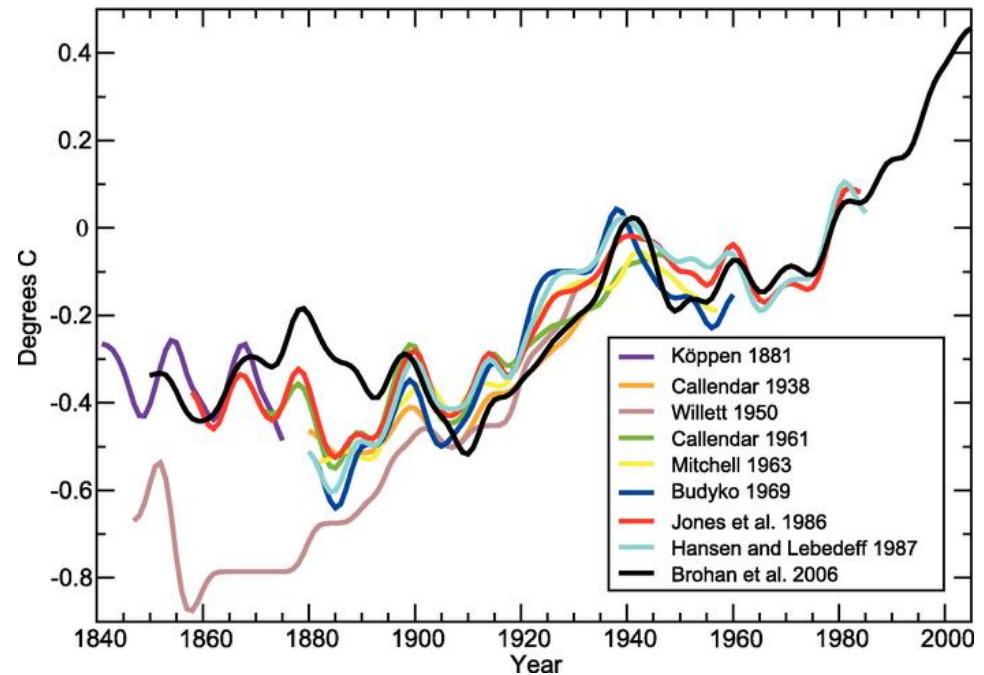
Temporal Variability

Impact Assessment

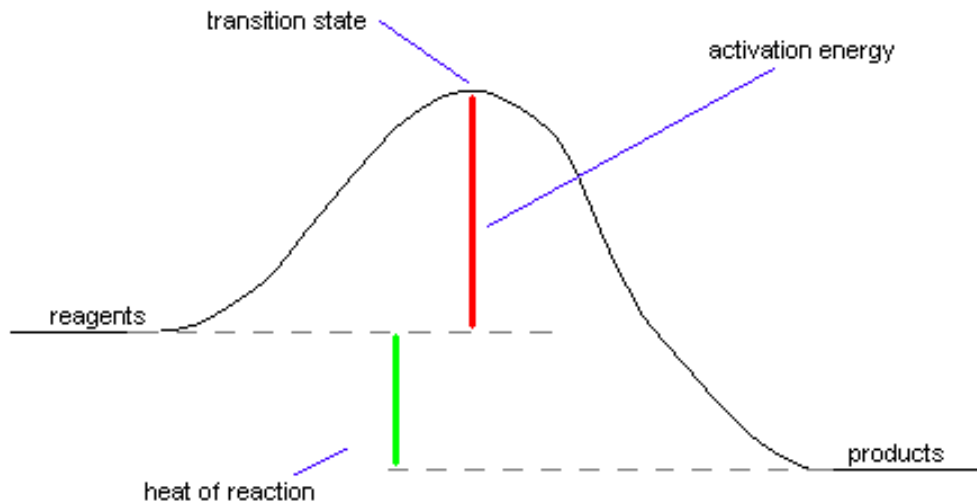
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Global Temperature Time Series



http://www.ipcc.ch/publications_and_data/ar4/wg1/en/figure-1-3.html



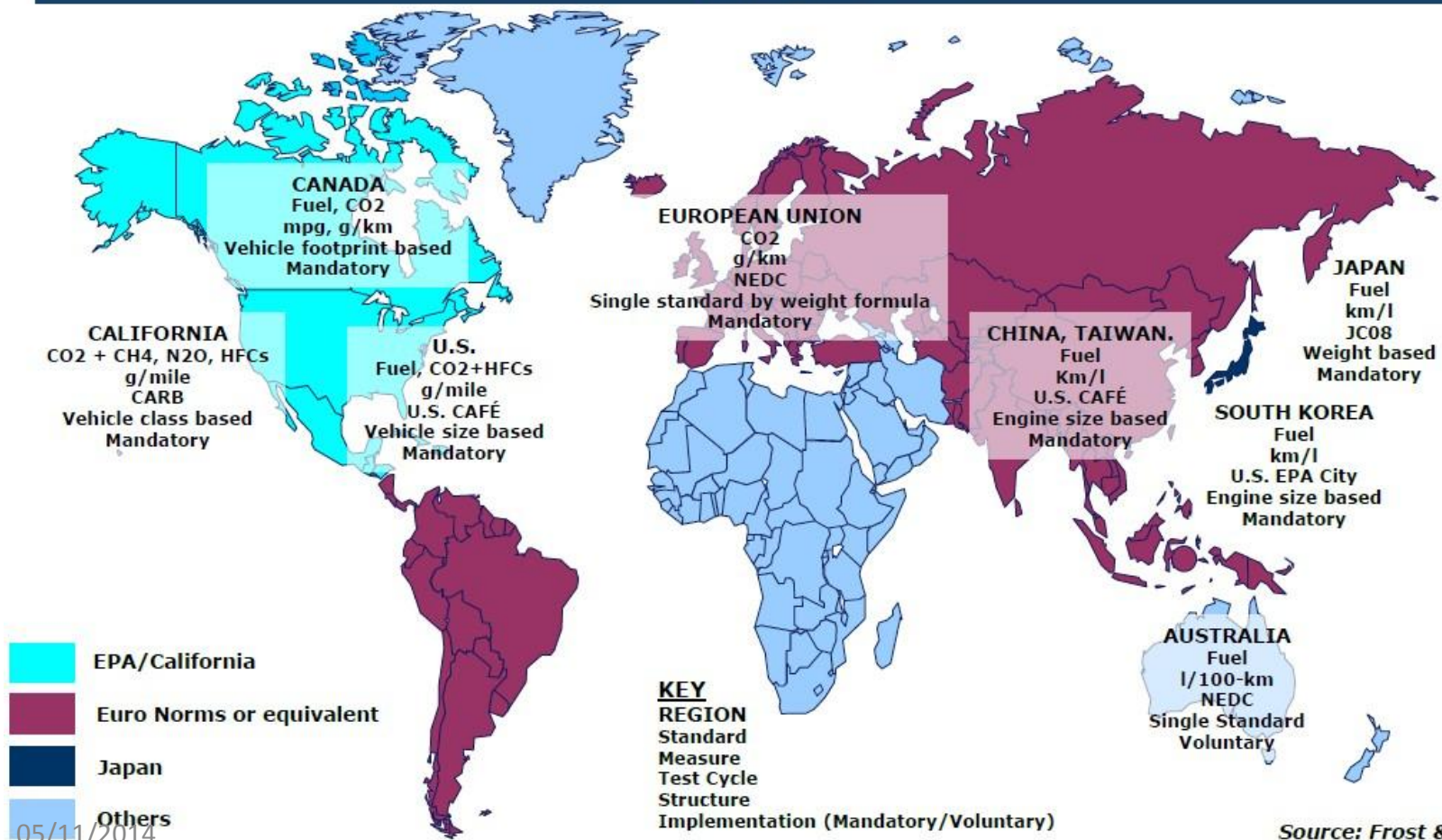
Spatial Variability

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Spatial Variability

Inventory Analysis
8. Regional differences between factories

Global Emission Regulations: Emission Regulations Across Regions (World), 2009



05/11/2014

Source: Frost & Sullivan

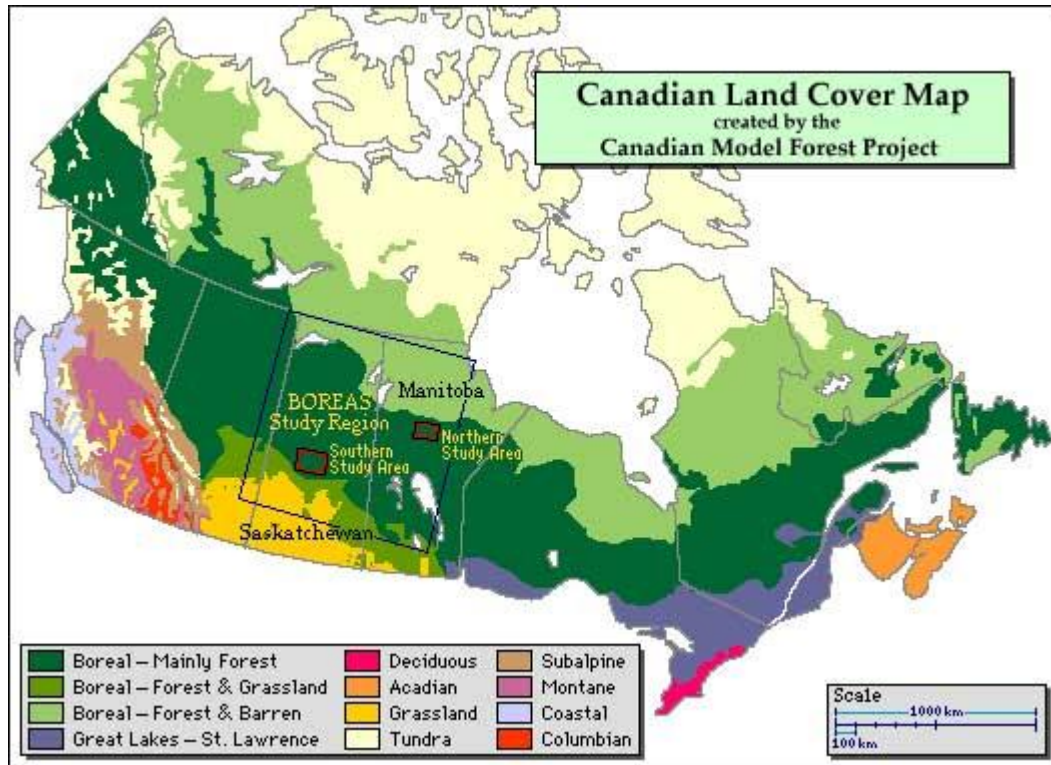
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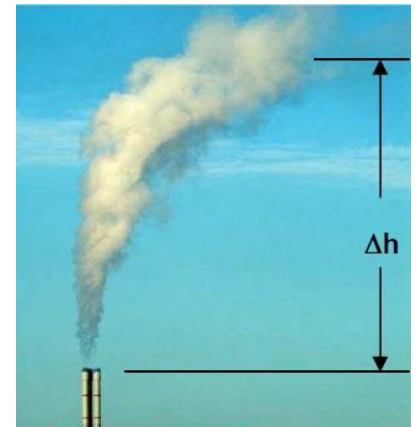
Spatial Variability

Impact Assessment

6. Regional differences in environmental sensitivity (don't effect all areas the same)
7. Distribution of emissions



<http://earthobservatory.nasa.gov/Newsroom/view.php?id=23135>



Variability between objects/sources

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Variability between objects/ sources

Inventory Analysis
9. Difference b/n Factories/ 10. Technologies which produce same product



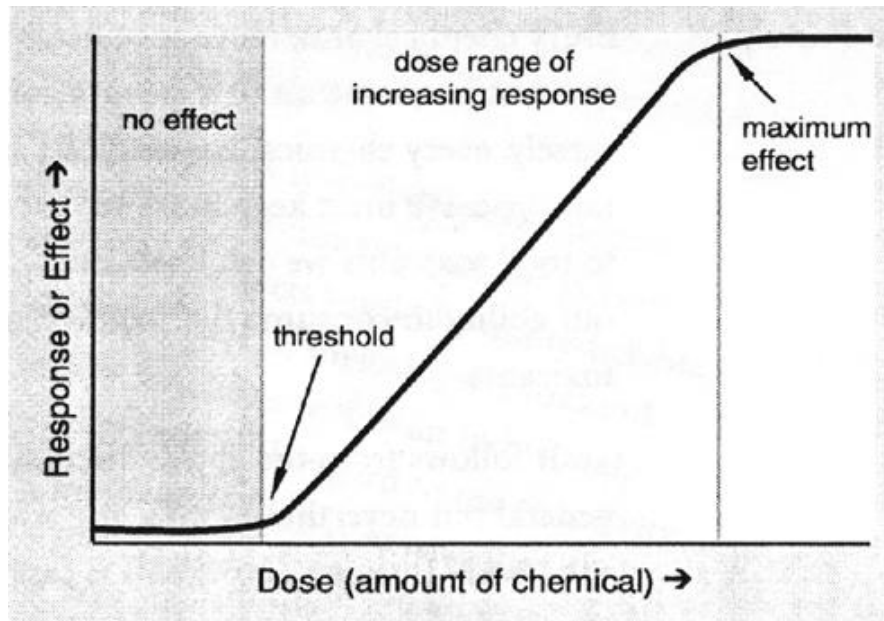
<http://www.buker.com/lean-manufacturing/education>

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Variability between objects/ sources

Impact Assessment
8. Differences in human exposure patterns



http://wiki.ubc.ca/Course:FNH200/Lesson_12

Types of Uncertainty at each LCA stage

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